WARM UP

(complete while I'm checking HW):

From yesterday's notes packet
worksheet #1, 3, 4

(55) a) $H_0: \mu_L = \mu_H$

$H_a: \mu_L \neq \mu_H$

$$t = \frac{\bar{X}_L - \bar{X}_H}{\sqrt{\frac{S_L^2}{n_L} + \frac{S_H^2}{n_H}}} = -8.23$$

$2 \cdot P(t < -8.23 \mid df = 21.8) = 1.97 \times 10^{-8}$

We reject Ho in favor of Ha b/c p-value of $1.97 \times 10^{-8} < \alpha$ (either 0.05 or 0.01). We have suff. evid. that the mean ego strength for low + high fitness is different

① $\boxed{\bar{X}_1 - \bar{X}_2} \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} = (2.9167, 6.4833)$

We are 95% conf. that the difference btw. the average # of accidents in the 2 depts. is btw. 2.9167 and 6.4833 accidents

$df = 57.9513$

③ $H_0: \mu_1 = \mu_2$

$H_a: \mu_1 > \mu_2$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} = 8.2459$$

$$P(t > 8.2459 \mid df = 77.146) = 1.687 \times 10^{-12} \approx 0$$

- reject
- avg nicotine content of Cig #1 > cig #2

NO

(4) $H_0: \mu_I = \mu_B$

$H_a: \mu_I \neq \mu_B$

$$t = 2.6040 = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

$$2 \cdot P(t > 2.6040 \mid df = 86.6260) = 0.0108$$

- reject H_0
- avg # bus lunches insurance is $\neq$ banking

NO

2 sample t-test

Review

Statistics

	Pop 1	Pop 2	
	n_1	n_2	
μ_1	$\bar{X}_1$	$\bar{X}_2$	μ_2
σ_2	S_1	S_2	σ_2

μ_2, σ_2 } unknown

Hyp:

$H_0: \mu_1 = \mu_2$ avg

$H_a: \mu_1 \overset{\neq}{\underset{>}{<}} \mu_2$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\underbrace{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}_{SE}}$$

- df = on calculator * more accurate

$P(t \geq \underline{\text{test stat}} \mid df = \quad) =$

as $n \uparrow$, t distr becomes closer to Z distr.
$s, \bar{x}$

$$(\bar{X}_1 - \bar{X}_2) \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} = (a, b)$$

Assump

1. 2 indep SRS
2. 2 normal pop
   or
   n_1
   n_2 ≥ 30

Calc:

2 samp T-test
T-Int

Pooled $\boxed{\text{NO}}$

Check

1. circled/assumed

Std. dev. — Pooled 2 samp t

* 2 samples from 2 distinct pop.
* both pop. have same σ

- use both S_1 and S_2
- combine S_1 and S_2 to make S_p - one Std. dev. that estimates σ

S_1 S_2 → S

$\hat{p}_1$, $\hat{p}_2$

Rvw

2 prop Int:

$$SE: \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

2 prop Test: Pooled

$H_0: p_1 = p_2$

$\hat{p}_1$ $\hat{p}_2$ → $\hat{p} = \frac{X_1 + X_2}{n_1 + n_2}$

$$SE: \sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

give more weight to the std. dev.
from larger n.

$n_1 = 50$ $\quad$ $n_2 = 75$

S_1 $\quad$ S_2 $\quad$ σ_2

$\bar{x}_1$ $\quad$ $\bar{x}_2$ $\quad$ μ_2

$$S_p = \sqrt{\frac{(n_1-1)(S_1^2) + (n_2-1)(S_2^2)}{n_1+n_2-2}}$$

$df = n_1 - 1$

S_p = pooled std. dev.
pooled estimator of σ

Pop 1	Pop 2
$\bar{X}_1$	$\bar{X}_2$
n_1	n_2
$\cancel{s_1}$	$\cancel{s_2}$

s_p

Hyp: same

Test Stat: $t = \dfrac{\bar{X}_1 - \bar{X}_2}{S_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$

P-val: same

df = $n_1 + n_2 - 2$

* on calc.

Concl: same

dd SE

$\sqrt{\dfrac{S_1^2}{n_1} + \dfrac{S_2^2}{n_2}}$

$\sqrt{S^2\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}$

$S_p\sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}$

$$\underbrace{(\bar{X}_1 - \bar{X}_2) \pm t^* S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}_{SE}$$

sentence: same

Calc: 2 samp T-test
T-Int

$S_1 = 2.12$ 5.7
$S_2 = 2.13$ 8.9

Pooled: $\boxed{\text{YES}}$

* problem says

* $S_1 \approx S_2 \rightarrow \sigma_1 = \sigma_2$

Ex:

$H_0: \mu_A = \mu_B$

$H_a: \mu_A > \mu_B$

* $s_1 \approx s_2$, so we think $\sigma_1 = \sigma_2$
and we'll pool s_1 & s_2.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = 0.423$$

$P(t > 0.423 \mid df = 34) = 0.337$

$H_0: \mu_A = \mu_B$

$H_a: \mu_A > \mu_B$

* sample std. dev. are very similar

$\therefore$ we think $\sigma_1 = \sigma_2$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = 0.423$$

$$P(t > 0.423 \mid df = 34) = 0.337$$

p.56~~5~~2 #65

Skilled $\rightarrow$ SE $\rightarrow$ $s/\sqrt{n}$

Variances σ^2

$\sigma_1 \neq \sigma_2$ Unequal

$\sigma_1 = \sigma_2$ ~~Equal~~

pooled

#1

$H_0: \mu_{1978} = \mu_{1998}$

$H_a: \mu_{1978} < \mu_{1998}$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = -4.25$$

$$P(t < -4.25 \mid df = 898) = 1.188 \times 10^{-5}$$

- reject
- avg ht of 1978 is less than avg ht of 1998

② $\bar{X}_1 - \bar{X}_2 \pm t^* s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$

$= (-0.9989, -0.4011)$ $df = 898$

We are 93% conf. that the diff. btw. the mean hts of 1978 + 1998 is btw. 0.4011 and 0.9989?